National Semiconductor

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DT1056/DT1057 DIGITALKER™ Standard Vocabulary Kit

General Description

The DIGITALKER™ is a speech synthesis system consisting of several N-channel MOS integrated circuits. It contains a speech processor chip (SPC) and speech ROM and when used with external filter, amplifier, and speaker, produces a system which generates high quality speech including the natural inflection and emphasis of the original speech. Male, female, and children's voices can be synthesized.

The SPC communicates with the speech ROM, which contains the compressed speech data as well as the frequency and amplitude data required for speech output. Up to 128k bits of speech data can be directly accessed.

With the addition of an external resistor, on-chip debounce is provided for use with a switch interface.

An interrupt is generated at the end of each speech sequence so that several sequences or words can be cascaded to form different speech expressions.

The DT1056/DT1057 is a standard DIGITALKER kit encoded with 131 separate and useful words (see the Master Word List Table I) and when used with the DT1050 Standard Vocabulary Kit, provides a library of 274 useful words. The words have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences.

The "voice" output of the DT1056/DT1057 is a highly intelligible male voice. The vocabulary is chosen so that it is applicable to many products and markets.

Features

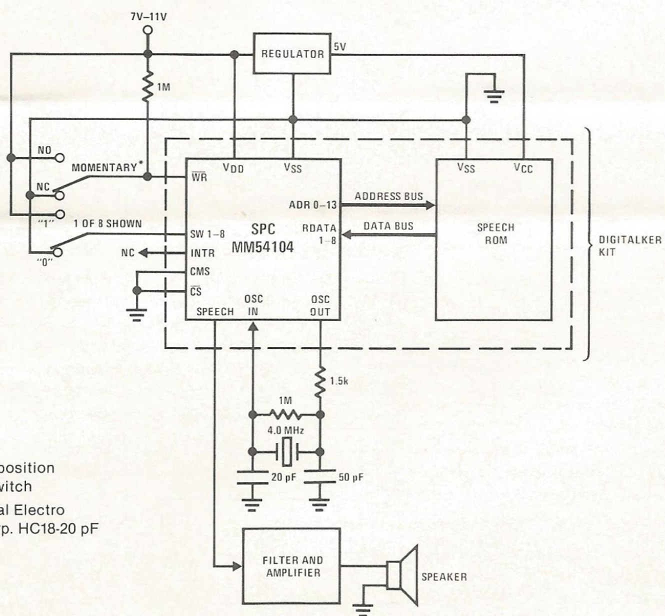
- Easily adaptable to DT1050 Standard Vocabulary Kit
- 131 useful words
- COPS™ and MICROBUS™ compatible
- Designed to be easily interfaced to other popular microprocessors
- Natural inflection and emphasis of original speech
- Addresses 128k bits of ROM directly
- TTL compatible
- On-chip switch debounce for interfacing to manual switches independent of a microprocessor
- Interrupt capability for cascading words or phrases
- Crystal controlled or externally driven oscillator
- Available in complete kit (DT1056) or speech ROMs only (DT1057)

Applications

- Telecommunications
- Appliance
- Automotive
- Teaching aids
- Consumer products
- Clocks
- Language translation
- Annunciators

Typical Applications

Minimum Configuration Using Switch Interface



*Single pole 2 position momentary switch

**4.0 MHz crystal Electro Dynamics Corp. HC18-20 pF

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Absolute Maximum Ratings*

Storage Temperature Range	−65°C to +150°C	Voltage at Any Pin	12V
Operating Temperature Range	0°C to 70°C	Operating Voltage Range, V_{DD}-V_{SS}	7V to 11V
V_{DD}-V_{SS}	12V	Lead Temperature (Soldering, 10 seconds)	300°C

DC Electrical Characteristics* $T_A = 0°C$ to 70°C, $V_{DD} = 7V$-11V, $V_{SS} = 0V$, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IL}	Input Low Voltage		−0.3		0.8	V
V_{IH}	Input High Voltage		2.0		V_{DD}	V
V_{OL}	Output Low Voltage	$I_{OL} = 1.6$ mA			0.4	V
V_{OH}	Output High Voltage	$I_{OH} = -100$ μA	2.4		5.0	V
V_{ILX}	Clock Input Low Voltage		−0.3		1.2	V
V_{IHX}	Clock Input High Voltage		5.5		V_{DD}	V
I_{DD}	Power Supply Current				45	mA
I_{IL}	Input Leakage				±10	μA
I_{ILX}	Clock Input Leakage				±10	μA
V_S	Silence Voltage			0.45 V_{DD}		V
V_{OUT}	Peak to Peak Speech Output	$V_{DD} = 11V$		2.0		V
R_{EXT}	External Load on Speech Output	R_{EXT} Connected Between Speech Output and V_{SS}	50			kΩ

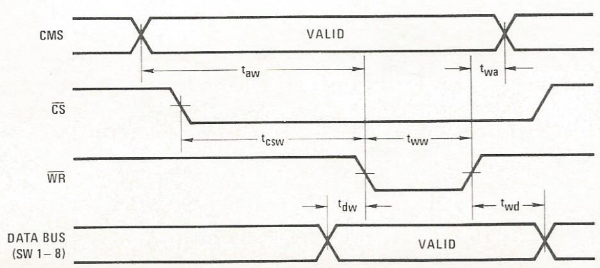
AC Electrical Characteristics* $T_A = 0°C$ to 70°C, $V_{DD} = 7V$-11V, $V_{SS} = 0V$, unless otherwise specified.

Symbol	Parameter	Min	Max	Units
t_{aw}	CMS Valid to Write Strobe	350		ns
t_{csw}	Chip Select ON to Write Strobe	310		ns
t_{dw}	Data Bus Valid to Write Strobe	50		ns
t_{wa}	CMS Hold Time after Write Strobe	50		ns
t_{wd}	Data Bus Hold Time after Write Strobe	100		ns
t_{ww}	Write Strobe Width (50% Point)	430		ns
t_{red}	$\overline{ROMEN}$ ON to Valid ROM Data		2	μs
t_{wss}	Write Strobe to Speech Output Delay		410	μs
f_t	External Clock Frequency	3.92	4.08	MHz

Note: Rise and fall times (10% to 90%) of MICROBUS signals should be 50 ns maximum.
*SPC characteristics only. ROM characteristics covered by separate data sheet for MM52164.

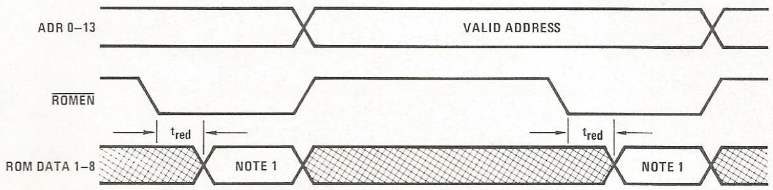
Timing Waveforms

Command Sequence



Timing Waveforms (Continued)

ROM Data Timing



Note 1: ROM Data 1-8 can go valid any time after ADR 0-13 changes, however it must be valid within the t_{red} spec and remain valid until $\overline{\text{ROMEN}}$ goes high.

Functional Description

The following describes the function of all SPC input and output pins.

Note: In the following descriptions, a low represents a logic 0 (0.4V nominal), and a high represents a logic 1 (2.4V nominal).

INPUT SIGNALS

Chip Select ($\overline{\text{CS}}$): The SPC is selected when $\overline{\text{CS}}$ is low. It is only necessary to have $\overline{\text{CS}}$ low during a command to the SPC. It is not necessary to hold $\overline{\text{CS}}$ low for the duration of the speech data.

Data Bus (SW 1-8): This is an 8-bit parallel data bus which contains the starting address of the speech data.

Data bus inputs SW 1-SW 8 accept an 8-bit binary address which is the address of the word which is to be "spoken" from the DIGITALKER output. See the Master Word List (Table I) for the complete listing of words and their respective addresses. If the entire word list is not used, unused inputs must be connected to V_{SS}.

Command Select (CMS): This line specifies the two commands to the SPC.

CMS	Function
0	Reset interrupt and start speech sequence
1	Reset interrupt only

Write Strobe ($\overline{\text{WR}}$): This line latches the starting address (SW 1-SW 8) into a register. On the rising edge of the $\overline{\text{WR}}$, the SPC starts execution of the command specified by CMS. The command sequence is shown in the timing waveform section. If a command to start a new speech sequence is issued during a speech sequence, the new speech sequence will be started immediately. When connecting $\overline{\text{WR}}$ to a switch, it must be a single pole 2 position switch as shown on page 1.

ROM Data (RDATA 1-8): This is an 8-bit parallel data bus which contains the speech data from the speech ROM.

OUTPUT SIGNALS

Interrupt (INTR): This signal goes high at the completion of any speech sequence. It is reset by the next valid command. It is also reset at power up.

ROM Address (ADR 0-ADR 13): This is a 14-bit parallel bus that supplies the address of the speech data to the speech ROM.

ROM Enable ($\overline{\text{ROMEN}}$): For low power applications, this line can be used to drive a transistor that switches the supply for static speech ROMs. See ROM Data Timing.

Speech Output (Speech Out): This is the analog output that represents the speech data. See frequency response section.

INPUT/OUTPUT SIGNALS

Clock Input/Output (OSC IN, OSC OUT): These two pins connect the main timing reference (crystal) to the SPC.

PHRASE QUALITY

In normal human speech, the brain puts durations of silence between the words to make the sentence flow smoothly. Since several durations of silence are provided in the Master Word List, the actual quality of any phrase can be significantly improved by adding durations of silence (also assigned addresses) between the words. As one thinks about how the phrase is actually spoken, one might assume the approximate duration of silence between each word, and insert the closest duration of silence from the word list. A hint in this area would be that for words beginning with the letters, K, T, P, B, D, and G insert 80 milliseconds silence prior to the words, and for words ending in the same letters as above, 40 milliseconds silence following the word is recommended.

Functional Description (Continued)

TABLE I. DT1056/DT1057* MASTER WORD LIST

Word	8-Bit Binary Address SW8 … SW1	Word	8-Bit Binary Address SW8 … SW1	Word	8-Bit Binary Address SW8 … SW1
ABORT	00000000	FARAD	00101100	PER	01011000
ADD	00000001	FAST	00101101	PICO	01011001
ADJUST	00000010	FASTER	00101110	PLACE	01011010
ALARM	00000011	FIFTH	00101111	PRESS	01011011
ALERT	00000100	FIRE	00110000	PRESSURE	01011100
ALL	00000101	FIRST	00110001	QUARTER	01011101
ASK	00000110	FLOOR	00110010	RANGE	01011110
ASSISTANCE	00000111	FORWARD	00110011	REACH	01011111
ATTENTION	00001000	FROM	00110100	RECEIVE	01100000
BRAKE	00001001	GAS	00110101	RECORD	01100001
BUTTON	00001010	GET	00110110	REPLACE	01100010
BUY	00001011	GOING	00110111	REVERSE	01100011
CALL	00001100	HALF	00111000	ROOM	01100100
CAUTION	00001101	HELLO	00111001	SAFE	01100101
CHANGE	00001110	HELP	00111010	SECURE	01100110
CIRCUIT	00001111	HERTZ	00111011	SELECT	01100111
CLEAR	00010000	HOLD	00111100	SEND	01101000
CLOSE	00010001	INCORRECT	00111101	SERVICE	01101001
COMPLETE	00010010	INCREASE	00111110	SIDE	01101010
CONNECT	00010011	INTRUDER	00111111	SLOW	01101011
CONTINUE	00010100	JUST	01000000	SLOWER	01101100
COPY	00010101	KEY	01000001	SMOKE	01101101
CORRECT	00010110	LEVEL	01000010	SOUTH	01101110
DATE	00010111	LOAD	01000011	STATION	01101111
DAY	00011000	LOCK	01000100	SWITCH	01110000
DECREASE	00011001	MEG	01000101	SYSTEM	01110001
DEPOSIT	00011010	MEGA	01000110	TEST	01110010
DIAL	00011011	MICRO	01000111	TH (NOTE 2)	01110011
DIVIDE	00011100	MORE	01001000	THANK	01110100
DOOR	00011101	MOVE	01001001	THIRD	01110101
EAST	00011110	NANO	01001010	THIS	01110110
ED (NOTE 1)	00011111	NEED	01001011	TOTAL	01110111
ED (NOTE 1)	00100000	NEXT	01001100	TURN	01111000
ED (NOTE 1)	00100001	NO	01001101	USE	01111001
ED (NOTE 1)	00100010	NORMAL	01001110	UTH (NOTE 3)	01111010
EMERGENCY	00100011	NORTH	01001111	WAITING	01111011
END	00100100	NOT	01010000	WARNING	01111100
ENTER	00100101	NOTICE	01010001	WATER	01111101
ENTRY	00100110	OHMS	01010010	WEST	01111110
ER	00100111	ONWARD	01010011	SWITCH	01111111
EVACUATE	00101000	OPEN	01010100	WINDOW	10000000
EXIT	00101001	OPERATOR	01010101	YES	10000001
FAIL	00101010	OR	01010110	ZONE	10000010
FAILURE	00101011	PASS	01010111		

*DT1056 is a complete kit including MM54104 SPC; DT1057 is SSR5 and SSR6 speech ROMs only.

Note 1: "ED" is a suffix that can be used to make any present tense word become a past tense word. The way we say "ED," however, does vary from one word to the next. For that reason, we have offered 4 different "ED" sounds. It is suggested that each "ED" be tested with the desired word for best quality results. Address 31 "ED" or 32 "ED" should be used with words ending in "T" or "D," such as exit or load. Address 34 "ED" should be used with words ending with soft sounds such as ask. Address 33 "ED" should be used with all other words.

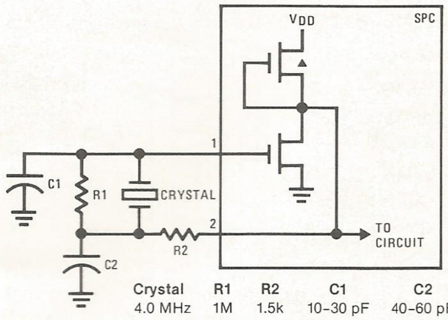
Note 2: "TH" is a suffix that can be added to words like six, seven, eight to form adjective words like sixth, seventh, eighth.

Note 3: "UTH" is a suffix that can be added to words like twenty, thirty, forty to form adjective words like thirtieth, fortieth, etc.

Note 4: Address 130 is the last legal address in this particular word list. Exceeding address 130 will produce pieces of unintelligible invalid speech data.

Crystal Circuit Information

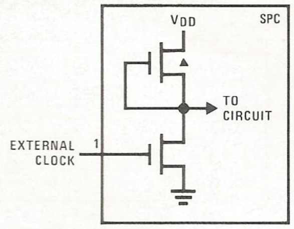
Typical Crystal Oscillator Network

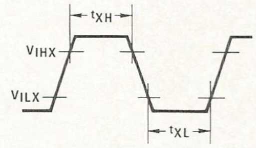


Crystal	R1	R2	C1	C2
4.0 MHz	1M	1.5k	10–30 pF	40–60 pF

(4.0 MHz crystal manufactured by Electro Dynamics Corp. P/N HC18-20 pF)

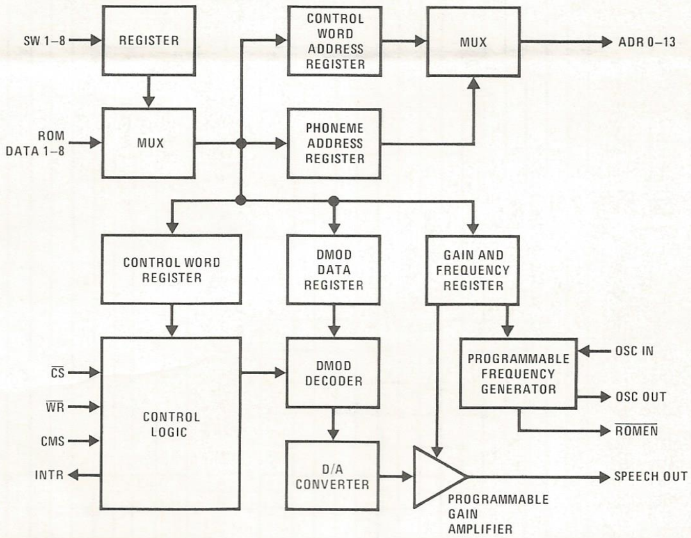
External Clock Input (4.0 MHz)



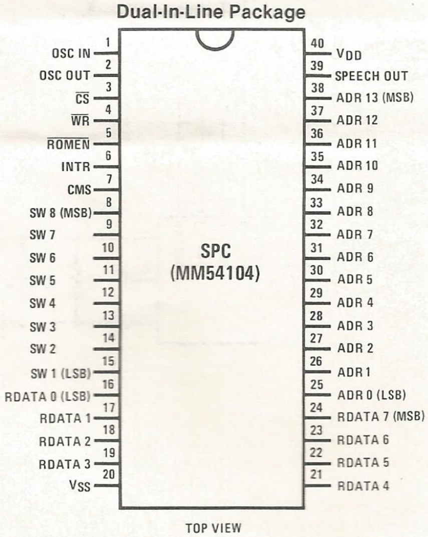


Timing	Min	Units
t_{XH}	100	ns
t_{XL}	100	ns

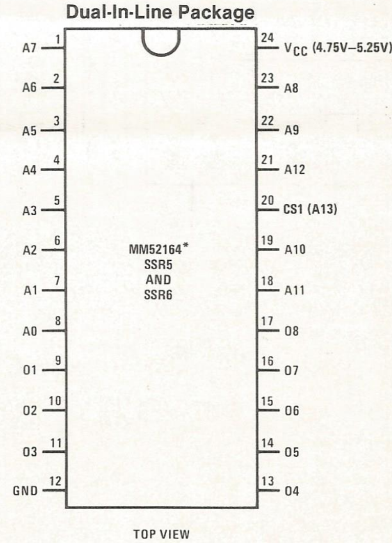
SPC Block and Connection Diagrams



Dual-In-Line Package

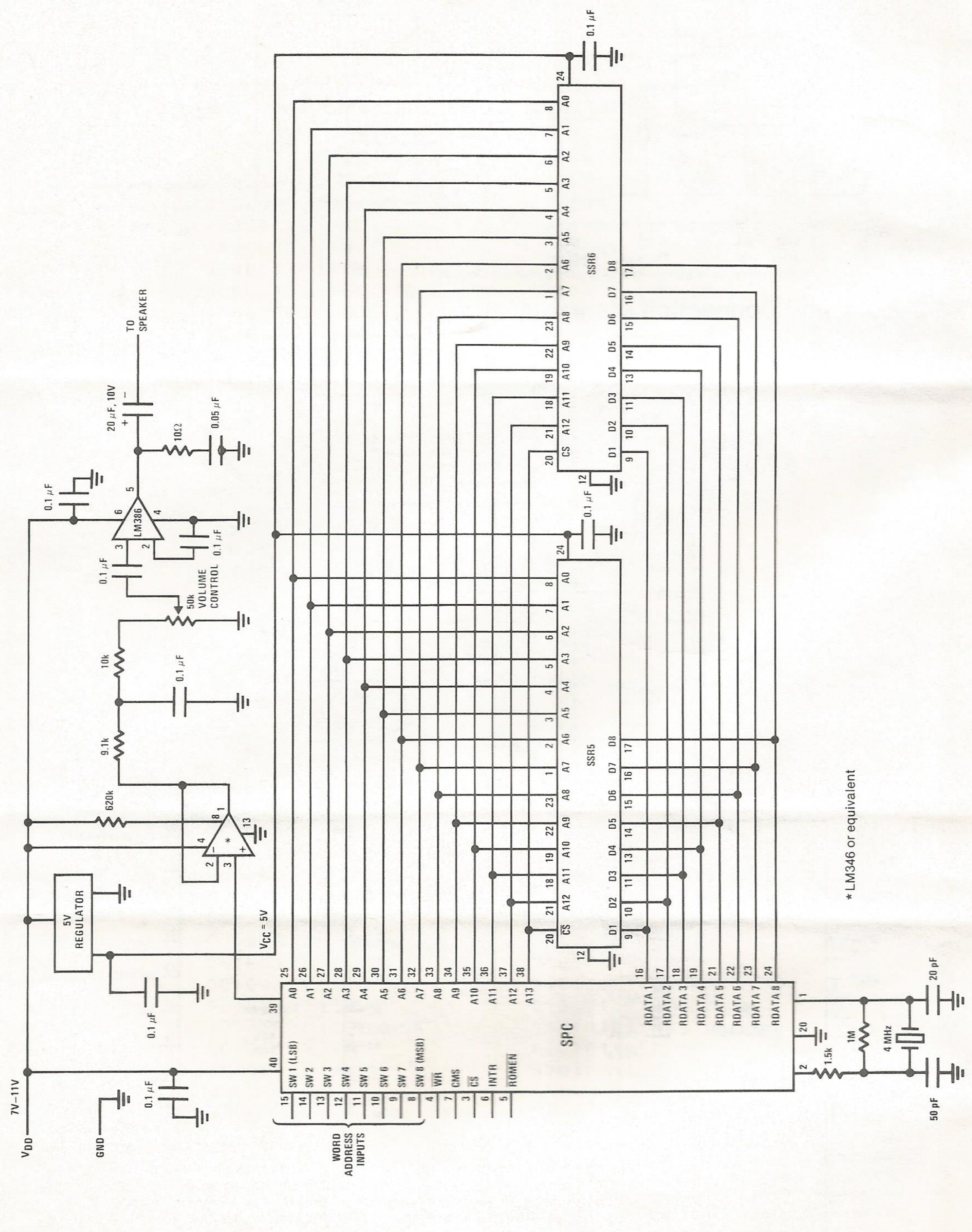


Dual-In-Line Package



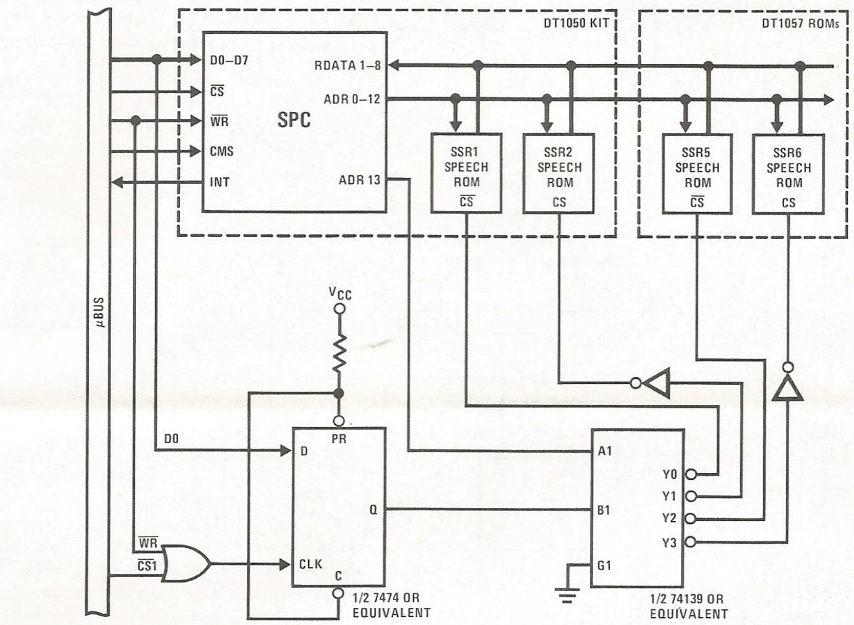
*For specific ROM device information, see MM52164 data sheet.

Recommended Schematic Diagram

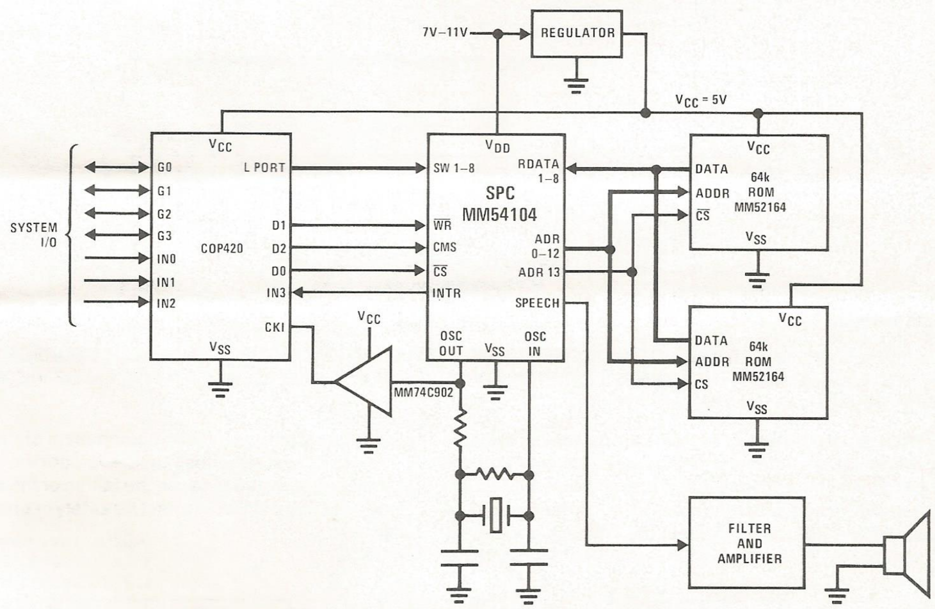


Typical Applications (Continued)

Integration of DT1057 ROMs and DT1050 Kit

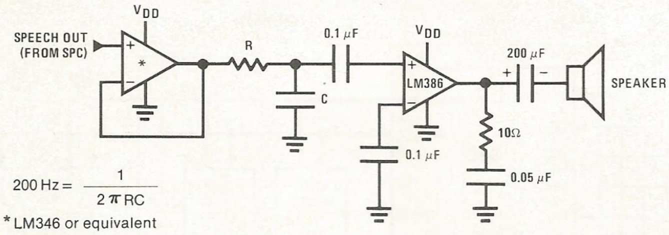


DIGITALKER System Using COP420 Interface



Typical Applications (Continued)

Minimum Filter Circuit

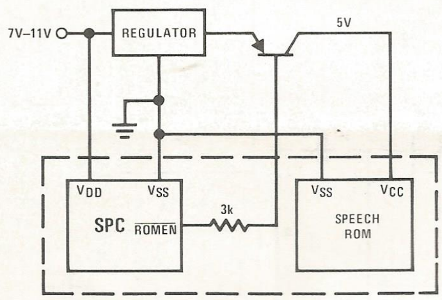


$$200\text{ Hz} = \frac{1}{2\pi RC}$$

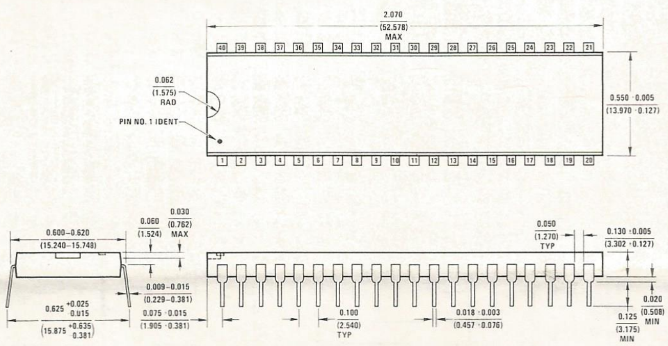
*LM346 or equivalent

See MM54104 data sheet for additional filter information.

Low Power Configuration Using Static ROM



Physical Dimensions inches (millimeters)



Molded Dual-In-Line Package (N)
NS Package Number N40A

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